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ABSTRACT

The National Research Council (NRC) initiated the first reform movement in 1994 in order to increase student achievement, provide curriculum reform, and involve teacher enhancement programs. This document reports on a study with qualitative and quantitative components that evaluated the results of the impacts of teacher enhancement and curriculum reform on student attitudes and achievement in five U.S. schools during the last six year period. The schools were located in California, Iowa, Montana, New York, and Texas. (YDS)

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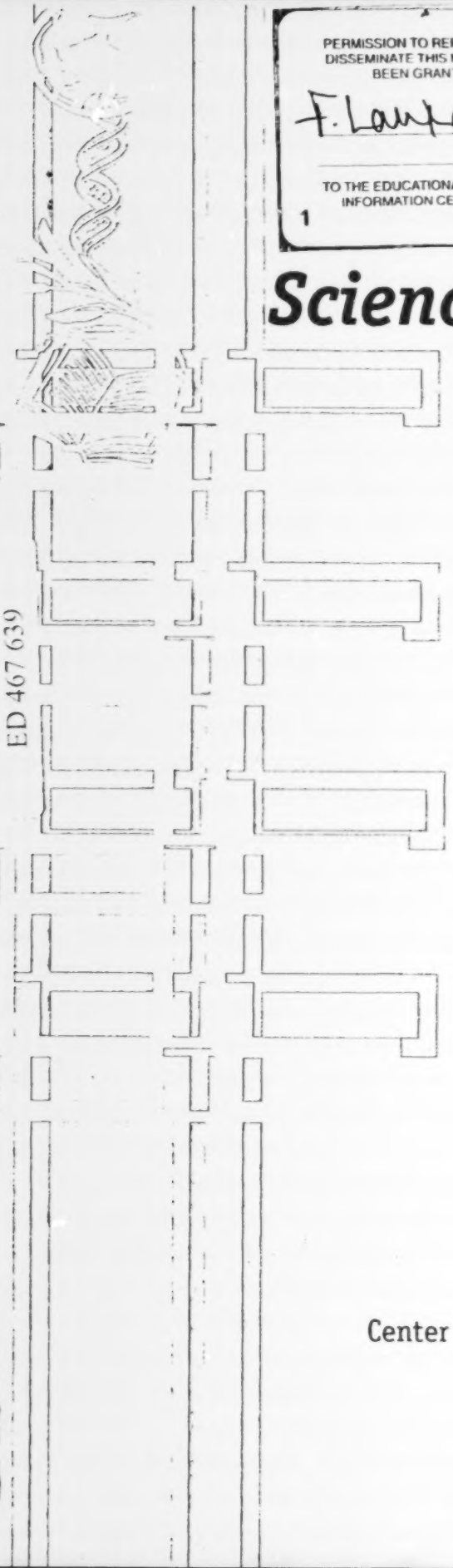

ED 467 639

Science Education Reform

The Impact of Teacher Enhancement & Curriculum Implementation on Student Performance 1995-2001

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The 21st century has been deemed the age of knowledge, information, science and technology. A critical component to America's success in the new millennium is improving science education for our young people. Recognizing this need, in 1994, the National Research Council established National Science Education Standards to help direct the future of science education in our nation's schools. The implementation of the standards into the schools occurred by way of curriculum reform and teacher enhancement efforts.

This study is an effort to evaluate one of the first reform projects implemented to translate the National Science Education Standards into classroom practice. Scope, Sequence and Coordination's (SS&C) goal was to help ninth grade science students achieve the science standards. Curriculum materials, summer training and liaison teacher support was provided to assist teachers in implementing the standards into their classrooms.

This evaluation examines the impact of teacher enhancement and curriculum reform in five U.S. schools over a six-year period. Schools represent diverse geographical locations, economic conditions and cultures. Achievement and attitudes of students are followed from 1995 to 2000. The impact of the reform on the schools and the changes that occurred to the initial reform over the six-year period are reported.

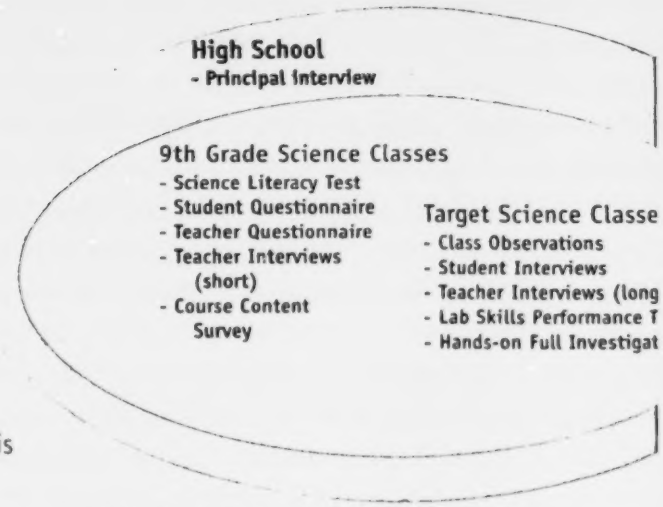
This report highlights our findings and provides insights and recommendations for future teacher enhancement, curriculum development and implementation of reform efforts.

Science Education Reform

For many years, the National Science Foundation (NSF) has funded teacher enhancement and curriculum development projects. Evidence shows that science and mathematics teachers need this sort of continuing, supplementary education. Ostensibly, the goal of teacher enhancement programs is to improve student outcomes. Despite the long history of science and mathematics teacher enhancement programs, U.S. students lag behind their international counterparts in science and mathematics achievement.

Most teacher enhancement studies have assessed participant opinions of the quality of the enhancement. More ambitious evaluations have documented changes in attitudes and content knowledge before and after participation, and yet others have gathered information on perceived behavior change in classrooms. Few evaluations have documented the actual effect of enhancement of teachers' classroom behavior on student outcomes. Even when these types of data are gathered, usually only one type of gathering method is employed despite the advantages of using a variety of methods. In addition, evaluations are often short-term and do not document the project's continuing effects.

This study attempts to fill the gap in teacher enhancement evaluation. By using a multiple-method, longitudinal evaluation based on teacher behavior



and student achievement, the study presents comparative case studies of five schools that were part of the SS&C science education reform effort. The case studies follow the effects in the schools for six years. Ninth grade students who participated in the reform effort each year were compared with ninth graders from the same site who had not participated.

History of SS&C Reform

Along with his associates, Bill Aldridge, former executive director of the National Science Teachers Association (NSTA), initiated the Scope, Sequence and Coordination (SS&C) reform effort based on a vision of science education. The vision is embodied by the title. Scope means the studies should be rigorous. Sequence means the students should have experiences first and then tie these experiences to concepts. Finally, coordination indicates that each science should be coordinated with its counterparts rather than presented one at a time.

This curriculum design contrasts with the typical U.S. "layer cake" curriculum

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where students study only one science per year. Because more than 50 percent of U.S. students take only one year of high school science, this model results in a skewed pattern of study. Minority students are even less likely to enroll in advanced science courses. Most European and Asian countries, which also tend to score higher than the U.S. on international comparisons of science achievement, teach every science every year. The NSTA sought to develop such a coordinated program that would allow all students to study all sciences every year. NSTA prepared teachers thoroughly by having liaison teachers in each school, inviting teachers to a summer training workshop before they implemented the curriculum, and providing them with a complete set of curriculum materials.

Our Study

Both qualitative and quantitative data were gathered from principals, teachers and students through extensive site visits and student outcome assessments. Achievement measures included a five-station, hands-on laboratory skills test, a general science literacy multiple-choice test, an open-ended constructed response test, and a design-experiment test (written and hands-on versions).

Data were collected from all participating students and teachers during site visits, except for the science literacy test. Site visits were conducted in the spring and fall each year. During the visits, we interviewed all ninth grade teachers and observed three target classes. In the spring, students were given a questionnaire to complete. In each target class, six to 12 students were randomly selected to take the lab skills performance tests instead of the questionnaire. One student from each target class was also interviewed. School principals were interviewed during fall visits.

Basic Tenets of SSIS

- Every student should study biology, chemistry, physics and earth/space sciences every year.
- Science teaching should consider students' prior knowledge and experience.
- Students should be provided with a sequence of content from concrete experiences and descriptive expression to abstract symbolism and quantitative expression.
- Students should be provided with concrete science phenomena experiences before using terminology that describes or represents those phenomena.
- Concepts, principles and theories should be revisited at successively higher levels of abstraction.
- Learning should be coordinated between the four subjects to interrelate basic concepts and principles.
- Teaching should utilize the short-term motivational power of relevance by connecting the science learned to non-science subjects, to practical applications of how technological devices work, and to the challenge of solving personal and societal problems that contain scientific components.
- Teaching should utilize the long-term motivational power of profound science understandings and of the awe that stems from understanding the force of just a few fundamental principles.
- Topic coverage should be greatly reduced and more emphasis should be placed on a better understanding of some fundamental science principles.
- Assessment methods, items and instruments to measure student skills, knowledge, understandings and attitudes should be consistent with the first nine tenets.

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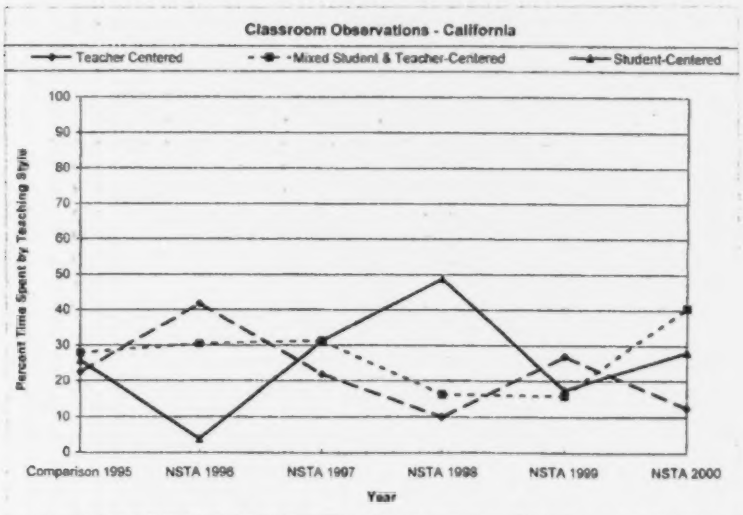
California

In California, the site was a large, urban high school with grades 9-12 that suffered overcrowding, a lack of academic and physical resources, and marginal building maintenance. The majority of the diverse student population came from low-income, working-class families. Approximately one-third spoke a first language other than English. Most were not college-bound. Teachers struggled daily to engage the students and keep them on task.



All of the ninth grade classes participated in SS&C. Over the years six or seven ninth grade science teachers taught the course. Two teachers attended the pre-study summer workshops and training for instructors. The liaison teacher was one of these two. He was department chair during the first three years and led the pilot testing and revision of activities. He helped new teachers implement SS&C.

The teachers met at lunch and after school to discuss lab activities and SS&C curriculum modifications. They also worked hard gathering materials, modifying lab activities to fit equipment, and discussing changes after trying activities. To accommodate the many limited-English-proficiency students, fewer activities were included and simpler readings were used. And like many urban schools, they lacked proper equipment so they modified SS&C by using everyday materials for activities.

In SS&C's third year, the state of California required all schools to administer a 40-question multiple-choice physical science test at the end of ninth grade. This pressured the school's science department to reorganize the subject matter emphasis and alter assessment methods. When SS&C began, the teachers shifted to predominantly essay, problem-solving and performance-based assessments. However, when the state began multiple-choice testing, the department included more multiple-choice testing in order to prepare students to answer such questions.

The classroom observations showed mixed movement in the types of classroom activities. During SS&C's first year, there was a significant increase in teacher-centered activities (approximately 40 percent of class time), followed by a time decrease (back to comparison-year levels) in the second year (30 per-

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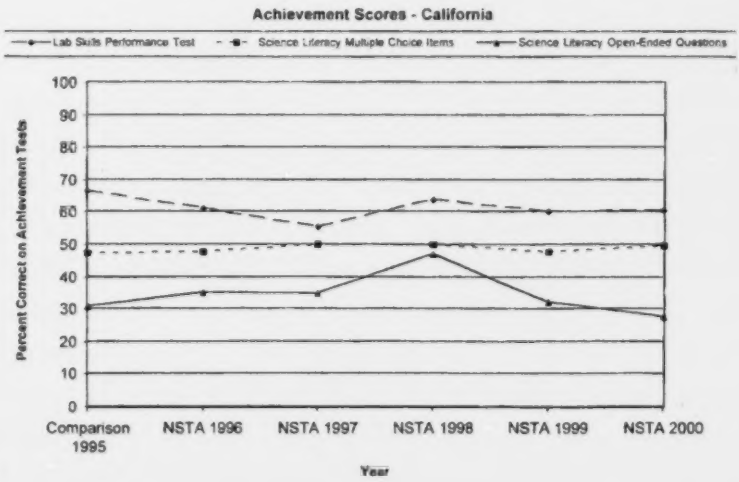
cent). In the third year there was a significant time increase in student-centered instruction (50 percent). During the fourth and fifth years there was a move back toward more teacher-centered and more teacher- and student-centered instruction (30 percent each year). The teacher and student self-report data show similar patterns. The student attitude and motivation data showed only minor changes that fluctuate from year to year.

The student achievement data show some increases in contrast to the comparison year. The multiple-choice scores were significantly higher in 1997, 1998 and 2000 and the open-ended item scores were notably higher in 1997. The laboratory skills performance test scores were stable.

The California site made a good faith effort to implement SS&C as intended, despite a challenging student population and lack of resources. However, after the first years they began to replace and modify some SS&C activities to better fit their students and equipment. In the end they kept approximately half of the SS&C activities, although the SS&C philosophy remained intact.

A Principal's View of Improvement

The principal was very supportive of SS&C. He said that the science department was one of the school's best departments, and he was quite impressed by its commitment and desire to improve. He was disappointed in the low science-test scores and concerned about the large percentage of failing students, but was encouraged that the department was at least attempting to improve. Despite money and space constraints, this principal provided funds to buy additional equipment and storage cabinets so teachers could organize materials. In addition, the administration added running water to several science classrooms to help teachers implement SS&C. Sometimes the means to improvement are very fundamental.



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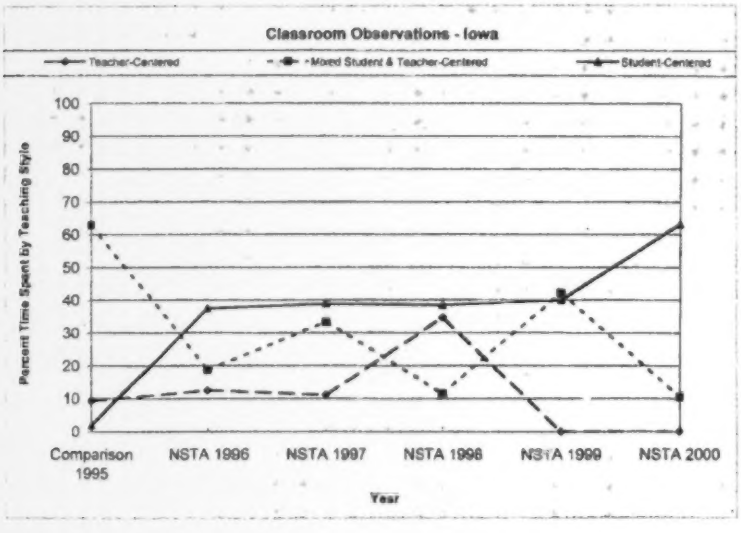
Iowa

The Iowa site was a well-maintained and adequately equipped school in a suburb of a medium-sized city. Class sizes over the years ranged from 18 to 25, and the student population was almost entirely Caucasian. All ninth graders (except for a small group of honors students) participated. There were few behavior problems. The attendance rate was above 95 percent and students were involved in school programs. More than 90 percent of the students continued their education after high school.



There were seven science teachers in the school each of the study years; two taught ninth grade. All were dedicated to making the science experience the best they could for their students. Two who attended the pre-study training taught the SS&C course for the first two years, and then one new teacher and another hired the next year took over the ninth grade teaching. The former teachers mentored the new teachers. The teachers felt they were doing a good job before SS&C, but were willing to try new things. The liaison teachers (now retired) were senior department members who strongly supported the ninth grade teachers. Both individuals answered questions and provided support for supplies and for paid time to work on the curriculum. The two principals supported the curriculum and worked to enhance the school's reputation in the community.

The curriculum contained much of the original SS&C material but it was changed annually to better fit the students. During the study's last year, the school used an integrated science textbook as well as SS&C materials. Administrators and concerned parents favored the textbook's use.

Classroom observation data showed a great increase in time spent in student-centered teaching during the first year, which was maintained through all study years. The percent of time spent doing student-centered teaching increased from about 10 percent to 40 percent in the first year and jumped to about 60 percent the last year. These teaching changes were corroborated by teacher and student reports of classroom activities.

Despite greater student interest in sci-

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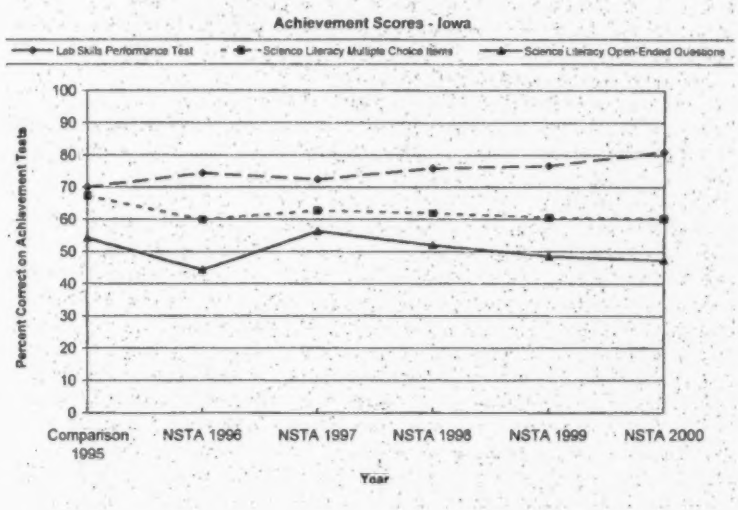
Student Motivation during Reform

Iowa students became more motivated and interested in science during the course of the study. The "totally awesome experience" item rated higher than the comparison year during SS&C's first year and remained high throughout the study. The "activities make you want to take more science" and "science class is motivating" were significantly higher than the comparison year in 1997 and remained high. Other attitude items corroborated this increase after the second year. Clearly, students in Iowa found the reform effort to be a positive experience.

ence, student achievement data showed mixed results. Students scored significantly lower on the multiple-choice test all years and on the open-ended items the first, fourth and fifth years of the new curriculum. The students scored significantly higher on the lab-skills test only during the study's last year but had showed steady improvement in their scores since the second year.

The Iowa high school implementation was complete. The school was well supplied to support the curriculum, the teachers were well qualified, and the administration was supportive. The first enacted curriculum was close to the intended curriculum, with slightly less student focus. Teachers felt the curriculum had promise and modified it during the second year. The curriculum also helped to "modify" the teachers with the classes becoming more and more student-centered. This pattern of improvement continued throughout the length of the project.



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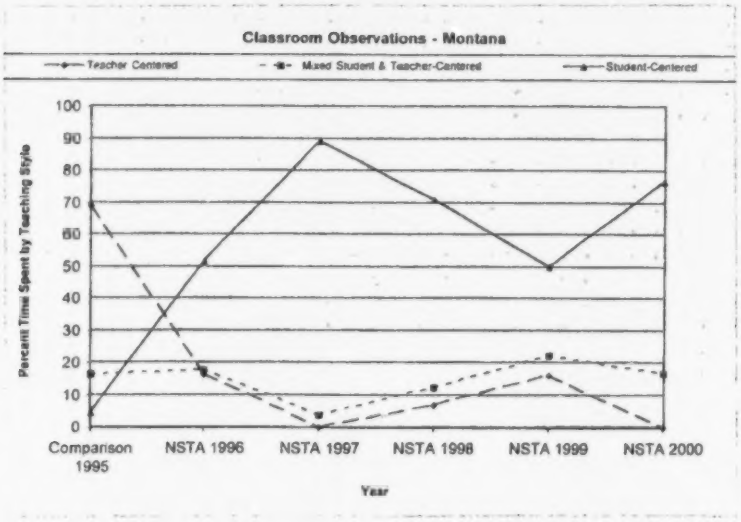
Montana

The Montana site was a traditional eighth and ninth grade junior high school in a small mountain city. The school had more than 500 mostly middle-class, Caucasian ninth graders. Most students were college bound and motivated to do well. SS&C was offered as one of four choices for ninth graders.



Over the years, SS&C interest and enrollment increased as more and students and parents believed in its positive impact. The principal was very supportive of SS&C and, based on the increased student enrollment, believed the program served students very well. The liaison teacher was the district's high school science department chair. He did not teach SS&C, but helped develop and implement activities. He was a big supporter of SS&C and helped develop chemistry activities for the national project. He helped provide money for new equipment and a vision of how SS&C activities fit into the district science scope and sequence curriculum.

There were two experienced teachers who were involved in the SS&C program from the very beginning but only one attended the summer workshops. They worked hard to plan lessons and gather equipment necessary to implement SS&C activities. These two, along with one other teacher, taught all SS&C sections for the project's first three years. But by the project's fourth year new teachers began teaching SS&C. However, the former teachers organized the materials so well that it was easy to bring in new teachers. Classes were scheduled so teachers could share materials.

Classroom observation data showed a substantial increase in student-centered instruction the first years of SS&C, which remained throughout the study. Teacher-centered activities showed a related decrease from about 70 percent of the time down to 15 percent. These findings were corroborated by the teacher and student self-report data.

There were few changes in student attitude and motivation during the project, as they were positive from the start and remained that way.

The student achievement data show positive effects for the performance tests.

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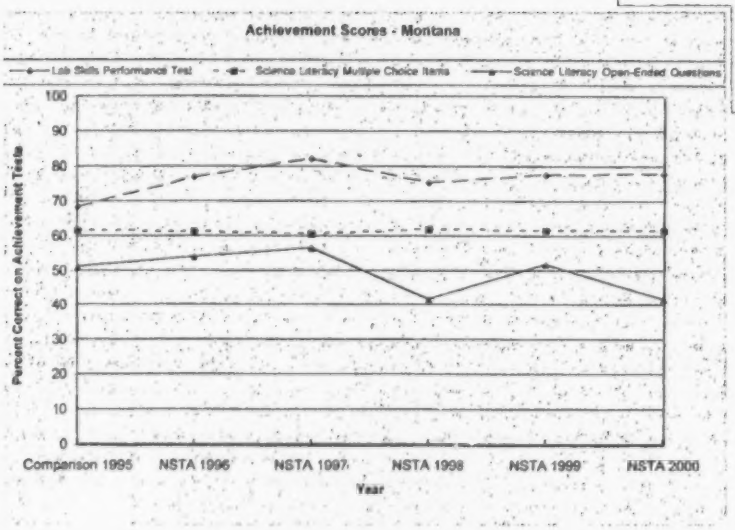
The labskills performance test scores for four of the five years of SS&C were significantly higher than for the comparison group. There were no significant differences on the multiple-choice items but there were significant decreases in two years on the open-ended items.

Parents & Schools Working Together

The Montana site made a very careful and concerted effort to implement SS&C. The intended SS&C curriculum was only slightly modified to fit the school. Since both parents and students could choose classes, parental and student perceptions were critical to SS&C's continued use. As it was, student outcomes were perceived as positive, and interest and enrollments increased during SS&C's second year. Prior to SS&C, the teachers had used labs and believed in hands-on science. With SS&C, students gained much more control. The more inquiry-oriented SS&C methods opened the teachers' eyes to how much more students could do. At the project's end, SS&C was still being used and it seems the science department will offer SS&C well into the future.



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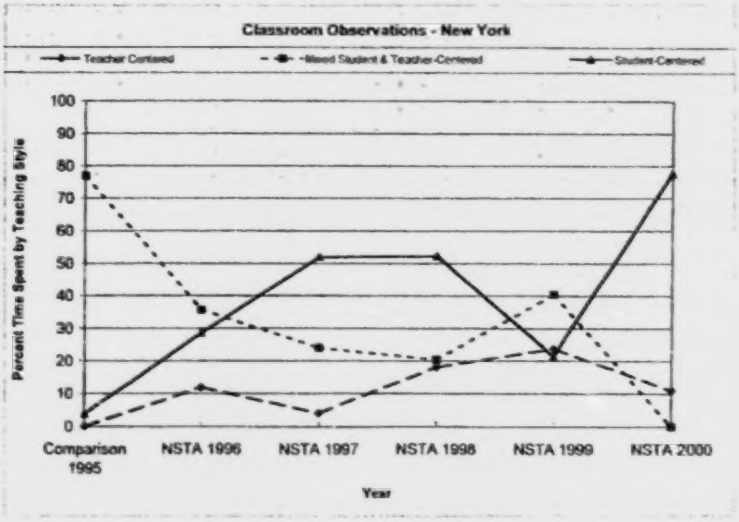
New York

The New York site was a large, well-supplied, ethnically and socioeconomically mixed high school in a suburban area. Due to the New York State Board of Regents graduation requirements, only some students took the reform course and most were not college bound.

The school had well qualified teachers selected for their science and teaching expertise. They were in touch with national science education research. There was a mix of new and old teachers, with most teachers staying until they retired. There were approximately ten science teachers during the study. Several teachers attended the national pre-study training and then adapted SS&C to their needs. Teams of four teachers representing each content area taught courses. This occurred the first three years but afterwards only one or two teachers taught the course. The liaison teacher was in charge and encouraged teachers to implement the program. He worked with the principal to support the curriculum and made sure teacher schedules provided sufficient time.



Classroom observation data showed mixed changes toward a more student-centered environment. Student-centered behaviors changed from 10 percent of the time to about 50 percent and rose to 75 percent after a brief decline to 20 percent in 1999. These instructional patterns were corroborated by teacher and student self-report data.

Student motivation fluctuated throughout the study. Initially, motiviation increased the first year, followed by a two-year decline, an increase in the fourth year, and a strong decline the last year. The increase in choosing a science career in 1999 was statistically significant as were the decreases in 1998 in "science class being motivating" and "science activities making the students want to take more science." The decrease in 2000 also was significant. This pattern of fluctuation was similar for other attitude items.

Student achievement results show some improvement over the comparison year. The lab-skills performance test and the open-ended items showed significant increases for the first three years of the reform, returned to comparison-year lev-

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els, and then rose markedly the final year. These results were similar to those on other achievement measures.

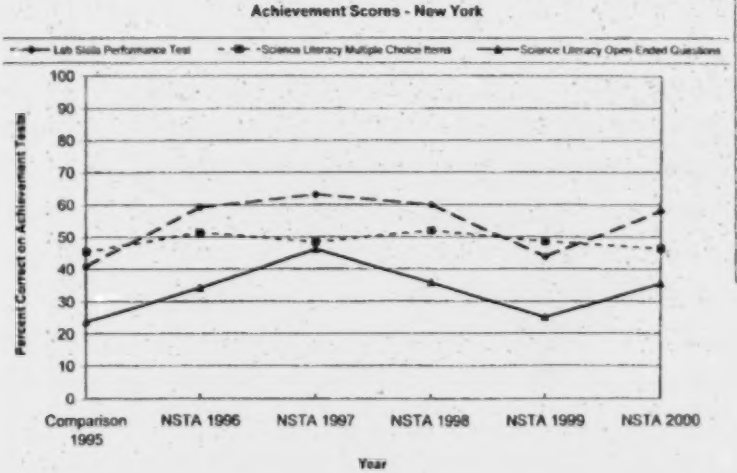
In addition to changes due to different teachers, the state and school changed its support of the course. At first the course was an acceptable graduation requirement. During the study, however, the rules changed and the course was no longer acceptable. Therefore, the course's value was significantly decreased. The prestige was further diminished through the administration's rescheduling of students who could take the course so that student participation included more special-education students. By the fourth year, nothing of the original project was left except in the attitudes of some of the newer teachers who had participated in the training. However, the curriculum that replaced the reform also was standards-based and inquiry-oriented.

Working Through Teacher Reluctance

The New York site was well equipped to implement the curriculum, and the principal and department head were supportive. The teachers were well qualified and believed in inquiry-based science instruction. But several teachers had mixed feelings or were actively opposed to the curriculum. Many believed what they were doing was better than anything SS&C could provide.

The first year the teachers implemented a team-taught version of SS&C that reflected their own skills and perceptions. The classes were very student-centered and hands-on, and student attitude and achievement increased slightly. But teacher perceptions about the curriculum were not all positive. At times, attitudes toward the curriculum were based more on attitudes toward the liaison teacher who was supportive of the curriculum than on the curriculum itself.

Because of these mixed impressions and the different teachers involved each year, the curriculum was continuously and significantly modified. No teachers had the course as a continuous responsibility and eventually, the course was taught by only one teacher.



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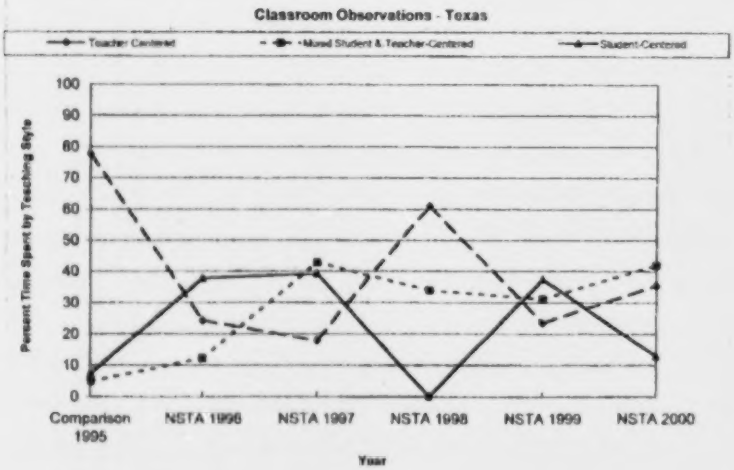
Texas

The Texas site was a large, mostly African-American populated high school in a very large city. It was in a mixed community that ranged socioeconomically from very low to middle class. School security was tight. The principal was politically astute and supported SS&C. Facilities could not support SS&C, and although teachers tried to obtain necessary materials they generally were not successful. The students were very polite although many were not academically engaged. All ninth grade students took SS&C.

Three experienced teachers attended the pre-study national training and others took training provided by the school district and a local university. A large group of teachers taught ninth grade over the project's course because of high teacher turnover. Several new science teachers were hired each year. After the first year, only new teachers were responsible for teaching SS&C. For the last two years, the two teachers who had been originally trained returned to the study. For the first two years, the new teachers were encouraged to use the reform philosophy and lessons but the liaison teacher was not part of the team. The liaison teacher stopped being department chair after the second year and retired after the third year. In the third year, Texas mandated a physical science course for ninth graders, so SS&C could not be used, although some activities that fit into the new course were used by some teachers.



Classroom observations showed a significant decrease in teacher-centered behavior with significant increases in student-centered behavior for the first two years. Then teacher-centered behavior increased. Student-centered behavior ranged from a low of about 10 percent to a high of 40 percent and then decreased to about 10 percent. There was a sustained increase in teacher- and student-centered behavior. Teacher and student self-reports of activities corroborate these results.

Student motivation levels increased the first year and then trailed off with some measures returning to original levels. There were statistically significant and sustained differences in students finding their class "more motivating," from slightly below 50 percent to about 66 percent. For the first three years students reported significantly more "totally

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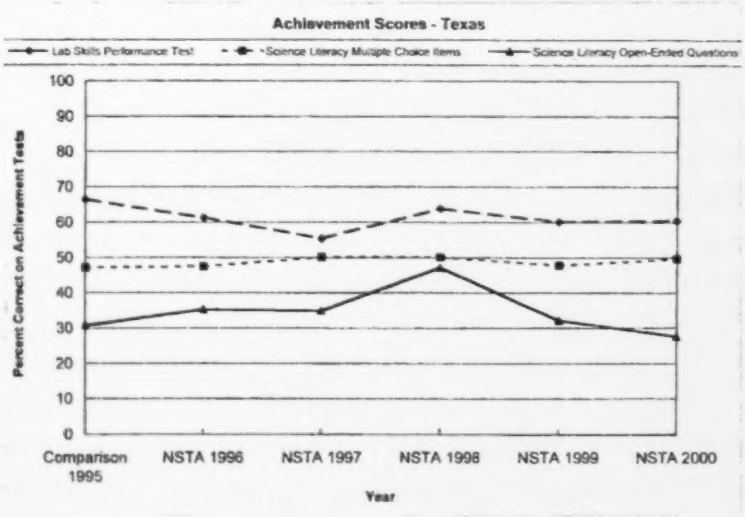
External Influences

At the Texas site, the faculty, the liaison teacher, the principal and the school district were supportive. However, the school did not have the resources to support reform activities. In addition, Texas instituted a high-stakes test and required physical science for all ninth graders. Consequently much class time was spent preparing students for the exam. These requirements meant that most SS&C curriculum was abandoned except for some physical science activities.

awesome" experiences (from 41 percent to 71 percent). There also were significant increases during the first year among students wanting to pursue science careers and in the first two years among those who wanted to take more science. Students found their science classes much more interesting during the study's first three years than during the comparison year and more "fun" over the first four years.

Achievement scores showed few effects on student outcomes despite strong effects on student attitude. The reform students had significantly higher scores than the comparison-year students on the lab-skills performance test during the first and third years. Significant decreases in contrast to comparison-year levels were found during the second, fourth and fifth years on the multiple-choice test and during the fourth and fifth years on the open-ended test.



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Insights

The most important insight was that each school was indeed unique and each used SS&C for its own purposes. Each school's individuality affected everything that occurred during the study. Common issues included resource division, the push-and-pull between different efforts, and staff turnover. What teachers were willing or able to do, or what might gain the most attention or status, determined what was implemented. Like other studies, the educational reform witnessed could best be explained in terms of how schools change reform, not how reform changes schools. The schools changed reform to fit their own wants and needs, not the wants and needs of the SS&C project.

Attitudes & Ownership

The structure for change within schools was a critical factor in the study's success or failure. This was a complex relationship and involved many aspects, including teachers specifically charged with implementation, the introduction of new teachers, the effectiness of the liaison teacher, and external requirements. The teachers were independent professionals who often worked in isolation and ultimately made their own decisions. It appeared that the teachers were most likely to implement reform when it was their choice to do so. This doesn't mean they couldn't be encouraged to change, but that change took time and teachers needed to develop ownership of the change. This fits with the constructivist philosophy in that learners need to construct their "own" understanding of a phenomenon before they accept it.

But it takes time to develop understanding and ownership. For an implementation to be successful, it probably should be used for at least three years. This idea allows teachers to try it the first year, adapt it, become more familiar with it the second year, and then begin to adopt it in the third year. This model implies that teachers who receive training also should be responsible for implementing changes and that they should be responsible for the change for at least three years. It also implies that teacher groups should be small enough so that each team member feels ownership and knows his or her input is needed. When pressures indicate that the curriculum may not last, teachers (probably wisely) do not invest the effort needed to develop ownership. Pressures can be positive or negative. For example, while this study was taking place, there was heightened national interest in the National Science Education Standards, which the SS&C curriculum was designed to match.

Coupled with the notion that change must come from teachers is the matter of the teacher's state of mind. Teacher reasons for becoming involved in the change varied from not really wanting to be involved, to thinking it was worth a try, to believing this was really the "right" thing to do. These prior concep-

tions about the curriculum and training greatly affected the implementation's success. Teachers who initially believed change would be important were more likely to implement change and develop ownership. Teachers who believed very strongly at the extremes either championed or sabotaged the effort. Although reform efforts need champions, sometimes these teachers were too pushy and hindered the reform. Those in the middle are probably representative of most teachers involved. They want to do the "right" thing but are not sure what is involved. They are usually concerned teachers who have been trying to do what is best for students and believe they have been doing well. This presents a difficult situation. The teachers have to change to something they do not know. To accomplish this, teachers need evidence that the change they are making is truly the "right" thing. They need support from their school, colleagues and students.

Support

Support includes both material and emotional support. Emotional support is a complex matter. Teachers need such support while experiencing change. They need to be led through change carefully so that they will not reject it. They also need to truly understand the nature of the changes they are supposed to make. This takes a facilitator and guide who is an enthusiastic leader. At the study sites, a guide who was not directly involved in the change was more effective, perhaps because it was someone who was not involved in everyday teaching challenges. It seems these guides should be in a position of power within schools. This provides teachers with a conduit to power and approval from powerful people. This sort of guide can help set the recognition and materials teachers need to implement the curriculum.

Student Feedback

Student feedback is important to teachers who are unsure about the value of change. The feedback is necessary to

Accessible Materials

Material support is less complex but no less important. If a hands-on active science program is to be implemented, teachers need materials. The materials need to be thoroughly tested to make sure they are used on a consistent basis. And teachers need to have enough supplies so all students can participate. But having the necessary materials is not enough. The materials also have to be easily available to support lessons. For example, one school put all of the materials and supplies into boxes, which ensured easy availability.

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support the change. At the study sites, information about student outcomes was both formal and informal. Students were seen as more interested in science or more engaged during class, or becoming better at designing experiments or in using scientific reasoning. Anecdotal comments were supportive of the changes. More formal information, such as enrollment data and increases on attitude toward science measures, was provided by the sites or through the evaluation efforts. In the situtation of state-mandated testing, teachers wanted their students to do well so they modified or abandoned the SS&C curriculum to improve student assessment results.

Learning Environments

Most educators think of changes in learning environments in terms of curriculum and instruction that could result in more desirable student outcomes. For instance, some thought that if the teaching was better, the students should have better attitudes and perform better. Previous research shows that a positive learning environment and a more inquiry-oriented instructional technique can boost student achievement. This was only partially true in this study.

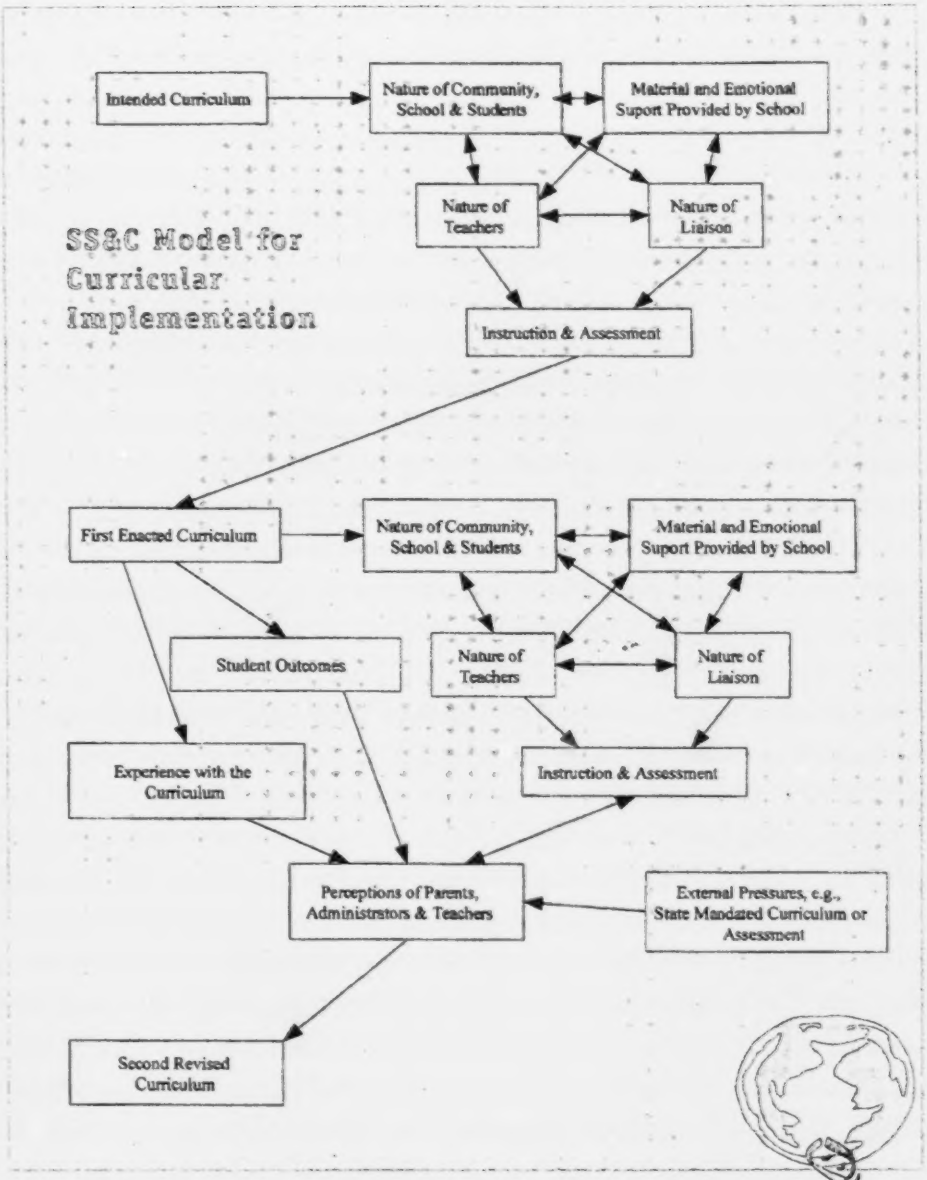
Given the significant instructional changes documented the first two years, there were surprisingly few increases in student outcomes. Changes were seen at some sites regarding motivation, and lab skills performance improved at most sites. Since the extent of implementation varied after the first two years, it is difficult to make generalized statements. However, at the continuing sites, it appears there was a consistent gain in lab-skills performance. There was a very small overall negative effect on the science literacy multiple-choice and open-ended tests.

It is difficult to explain the lack of a clear effect, given the strong changes in learning environments. We need to remember that achievement tests were not tied to the specific SS&C content. Tests were tied to the National Research Council standards and therefore were not designed to determine if a student actually learned what was taught. Nevertheless, the tests were psychometrically strong. The scales show strong factor structure and high reliabilities. The items were selected from existing and highly valid tests so the items themselves were valid. Independent science education experts examined the tests and said they matched the standards they were designed to measure. The tests show expected results regarding higher scores for students who have higher grades, standard patterns for achievement for different ethnic subsets, and gains in achievement for the overall sample from ninth grade to 10th grade.

Environment's Effect on Performance

One explanation is that learning environ-

ment has less effect on student performance than most want to believe. Overall, it appears that the reform effort successfully changed the way science was taught. However, the initial appearance and persistence of these changes were dependent on different elements. Some sites and individual teachers gained and retained more from the reform effort than others. Change institutionalization was greatly affected by external pressures and power structures related to reform, availability of support, and the desire for change. The data showed that if the same teachers continued to teach the reformed curriculum and adapted it to their environments, student achievement was more likely to be affected. It might be that as teachers become more experienced with reform, they become more comfortable teaching it, teach it more effectively, and convey clearer student performance expectations.


SS&C Model for Curricular Implementation
Intended Curriculum
Nature of Community, School & Students
Material and Emotional Suport Provided by School
Nature of Teachers
Nature of Liaison
Instruction & Assessment
First Enacted Curriculum
Nature of Community, School & Students
Material and Emotional Suport Provided by School
Student Outcomes
Nature of Teachers
Nature of Liaison
Experience with the Curriculum
Instruction & Assessment
Perceptions of Parents, Administrators & Teachers
External Pressures, e.g., State Mandated Curriculum or Assessment
Second Revised Curriculum

SS&C Model for Curricular Implementation

The model for curricular implementation is based on the idea that the intended curriculum is filtered and modified by a variety of contextual factors. With SS&C, the original curricular materials developed by NSTA were to be implemented at all sites. In reality, each site modified materials based upon the school's unique features. The intended SS&C curriculum was first filtered through four interrelated factors: the community; the school and students; the material and

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emotional support provided; and the teachers and the liaison teacher.

Each site started with the materials developed by NSTA, but then considered how the materials could be used in the school with its students. The intended curriculum also was "filtered" through the available support and resources. The nature of the teachers, such as their content understanding, teaching philosophy, openness to change, and of the liaison—such as his or her connections within the school power structure and facilitation skills—also were critical components of the curricular implementation. Ultimately, it was the teachers and the liaisons who made final decisions about the instruction and assessment that was used in the class.

This process resulted in the first enacted SS&C curriculum. This enacted curriculum was once again filtered through the same factors. But this time around, student outcome data and curriculum experiences were available. The teachers, parents and administrators had perceptions about the effectiveness of SS&C and these perceptions served as another filter for the curriculum. External pressures also affected the SS&C curriculum. State-mandated curriculum and assessment-modified SS&C implementation occurred at some sites. The result of this second filtering process was the implementation of the second enacted SS&C curriculum.

Theoretically, the process could continue into the future. Annually, the curriculum could be modified and reconsidered based upon student outcomes, local context and external pressures. The result is a cyclical curriculum implementation process that reconsiders and implements a modified curriculum each year.

Recommendations

Issues in Teacher Enhancement & Curricular Implementation

- Recognize that each school and teacher is unique and that each implementation also will be unique. A reform will be modified by individual sites.
- Recognize that external pressures such as curricular and assessment requirements may significantly affect new curricular implementation.
- Obtain district commitment to continue the implementation for at least three years with most of the same teachers. Effective change takes time.
- Obtain district commitment to provide the necessary facilities and materials as well as for making materials easily accessible.
- Involve teachers who either want to change or are willing to try it and withhold judgment until later. Do not force change on teachers.
- Involve teachers in curriculum material development to foster ownership and to help guarantee ease of implementation, but do not expect teachers to write the curriculum. The support of professional curriculum developers is needed in the initial development stages.
- Provide supportive local liaison teachers who have the knowledge necessary to be effective guides and who are part of the power structure. They can give teachers access to power and provide official approval of their efforts.
- Gather and provide relevant evidence to the teachers and schools that the changes are producing valuable effects. Don't expect achievement to change quickly.
- Develop strong communication networks within and between sites, and between sites and the centralized project staff to increase teacher feelings of involvement and ownership. The need for consistent and formal avenues of communication increases as the number of sites increases.

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Evaluation Tips

- A high quality, triangulated data collection with carefully scored instruments was worth the extra effort and cost.
- Mixed methods better addresses stakeholder needs.
- Planning the appropriate unit for data analyses in advance is important in the consideration of data collection procedures.
- It may not be appropriate to aggregate data.
- Having an external consultant helps to review and refine the evaluation approaches.
- Local support is very important for the collection of longitudinal data.
- You can never be too well organized.
- Data analyses have to be especially well documented.
- It is useful to have a mix of experience and backgrounds in the staff.
- It is helpful to produce reports and other peripheral publications as the evaluation progresses.

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